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ORIGINAL ARTICLE

# Medico-legal evaluation of firearm injuries during the period from 2005 to 2010 in the Suez Canal Area, Egypt: A retrospective study

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**Abstract** A retrospective study from 2005 to 2010 was carried out to evaluate firearm injuries and associated factors among their victims included cases referred to the Forensic Medicine Department, Ministry of Justice in Suez Canal Area. The total number of cases was 268. The total incidence in the Suez Canal Area was 10/100,000. Most of the victims were middle-aged males (259 cases; 96.6%). The male to female ratio was 28.8:1. One hundred and forty-four instances (53.7%) of firearm injuries occurred in the summer, with most of them happening at night (88 cases; 32.8%). Fatal injuries constituted 236 cases (88.1%), and most were homicides (176 cases; 65.7%). Thirty-six cases (13.4%) were accidents and 24 cases (9.0%) were suicides. The most common site of entry was the chest (67 cases; 25.0%), the head (53 cases; 19.8%). Automatic (machine) guns were responsible for 72 cases (26.9%). Locally made shotguns were responsible for 61 cases (22.8%) of firearm injuries; homemade guns represented 47 cases (17.5%). Air pistols were responsible for 20 cases (7.5%). These results support the argument that rigorous pursuit of campaign firearms without a license and arresting them is useful in reducing the number of firearm deaths in society and guns and air pistols should be banned.

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## 1. Introduction

Throughout the world deaths due to firearm weapons have increased tremendously.[1] Every year hundreds of thousands of people die from injuries caused by firearms.[2] Gun violence in the United States is an intensely debated political issue. Gun-related violence is the most common in poor urban areas and in conjunction with gang violence, often involving juveniles or young adults.[3,4] In the United States, the risk of death from firearms injuries versus death by RTA is relatively high.[5,6] On the other hand, in European countries; rates of death from firearm injuries are lower. In Sweden, for example,

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the mortality rate due to firearm injuries is about 200 per year, mainly due to suicides.[7] The same is true for Finland[8] and Denmark.[9] Also, it was reported that firearms are the main weapons used for committing murders in a study carried out in Pakistan.[10–12] In Egypt in 2000, there were about 117 fatal cases (83 accidental, 18 suicides, and 16 homicides), according to mortality statistics provided by WHO.[13]

The severity of firearms injuries is determined by two factors: The damage of the tissues caused by the mechanical interaction between the bullet and the tissues, and the effects of the temporary cavity produced by the bullet.[14] The medical, legal, and emotional costs of this violence impose an enormous burden on urban and rural trauma hospitals, and the courts, families, and society as a whole. The evaluation of these injuries requires specialized training and expertise, whether by an emergency physician in a living gunshot victim or a forensic pathologist in the deceased. There is growing concern about the indiscriminate use of firearms on a large scale, particularly in the last decade. The availability of firearms known as small arms and light weapons (SALW) has been described as a cancer spreading across the developing world.[13] It destabilizes political, social, and economic systems, and leads to injury, death, and chaos.[13–15]

While a lot of people do not consider an air gun a dangerous weapon, it can be. It may seem innocuous at first, but it can be a devastating, even deadly. Regrettably, these guns are considered toys for children. Therefore, accidents with air gun are progressively increasing.[16] Wounds from an air weapon are rarely fatal except when the head is struck, children are the usual victims. The pellet can enter the skull and traverse the whole width of the brain.[38]

Although the injuries air guns cause may be considered frivolous at first, they may involve major internal tissue pathologies. These seemingly frivolous injuries may have disastrous consequences if unnoticed. These machines are not innocent. In Egypt some accidental firearm injuries and fatalities were reported in rural areas, due to the use of air guns in weddings, holidays and festivals.[31]

Locally made illegal firearms are commonly used in criminal cases in developing countries.[21] One of the possible causes for the development of locally made firearms is that these weapons are very cheap and are readily available for criminals. Also, obtaining a licensed firearm is difficult. Firearms are made in the country blunt submitted by non-standard caliber cartridge two or more of the instrument. Projectiles used in firearms manufactured domestically are not subject to the fixed standards in the manufacture. The construction of these firearms is so poor that the fired cartridges can be easily distinguished from the very distinct markings found on them. These firearms are not very effective in the long run and are unreliable, because the material used to manufacture them is cheap.[37]

There is a powerful correlation between the acquisition of a firearm and its use in suicides, murders, assaults, and unintentional deaths. As a result of the invention of more advanced firearms and availability at the global level, death rates due to firearm injuries have increased dramatically.[17] In the USA the most frequent method of killing in cases of homicide and suicide is by means of firearms. More than 25,000 people die every year in the USA by injuries caused by firearms. Pakistan is not far behind from developed countries due to its tribal culture and borders with Afghanistan. Almost all kinds of weapons are manufactured in tribal areas.[3]

The incidence and pattern of firearm injuries and deaths in Suez Canal Area have not previously been studied. The study aims to evaluate firearm injuries and associated factors among their victims. The objective of the study is to outline the pattern of firearms injuries and deaths in the Suez Canal Area and compare it with the pattern seen in other parts of the world.

## 2. Methodology

This study is a retrospective case series conducted based on the analysis of all medico-legal reports related to fatal and nonfatal firearm cases between the years 2005 and 2010.

Cases were obtained from the archives of the Medico-Legal Department of the Ministry of Justice Suez Canal Branch. Agreement for perusal of records and appropriate data retrieval was obtained from the head office of Forensic Medicine Authority in the Ministry of Justice.

The Suez Canal Area Governorate consists of the following cities: Ismailia (942,832 inhabitants); South Sinai (157,000 inhabitants); El Suez (563,966 inhabitants); Port Said City (603,787 inhabitants) and El-Arish City "North Sinai" (421,576 inhabitants) at the end of 2010.

All firearm death records were thoroughly reviewed for the following informations:

- Demographic data of the victim, including, sex, residence, and occupation.
- The manner of death (suicide, accident, homicide, or undetermined).
- The date of the accident, further divided according to the season.
- The type of weapon used.
- Examination of the characteristics of firearm injuries.

Data collected were organized, tabulated, and statistically analyzed using SPSS software version 16.

## 3. Results

The study includes 268 victims of fatal (236 cases; 88.1%) and nonfatal (32 cases; 11.9%) firearms wounds; the largest number in the study period was found in El-Arish city (17.3/100,000), while the fewest were in Ismailia City (7.0/100,000) (Table 1). The largest number of cases was 53 (19.8%) in 2007, followed by 50 cases (18.7%) in 2010, 46 cases (17.2%) in 2005, 42 cases (15.7%) in 2009, 40 cases (14.9%) in 2006, and finally 37 cases (13.8%) in 2008 (Fig. 1). Of the victims, 259 (96.6%) were males and nine were females (3.4%), resulting in a male to female ratio of 28.8:1.

The most commonly affected age group was the age group of the third decade (119 cases; 44.4%). Of these cases, 115 (42.9%) were male, followed by those in their fourth decade (57 cases; 21.3%), 55 of which (20.5%) were male and (2 cases; 0.7%) were female. The second decade was the next most affected group (48 cases; 17.9%), followed by fifth decade (22cases; 8.2%) and the sixth decade (14 cases; 5.2%). Finally, the least affected age group was that above the sixth decade (8 cases; 3.0%). There was a statistically significant difference between males and females as regards the affected age groups (Table 2). There were 150 cases (56.0%) out of 268 cases of firearm injuries that occurred in rural areas, while 118 cases (44.0%) occurred in urban areas (Fig. 2). The most firearm

**Table 1** Number of inhabitants and incidence of firearm injuries in different cities of Suez Canal Area at the end of year 2010.

| Suez Canal Area cities | Numbers of inhabitants | Number and percent of firearm crimes | Incidence (/100,000) |
|---|---|---|---|
| Ismailia | 942.832 | 66 (24.6%) | 7.0 |
| South Sinai | 157.000 | 26 (6.0%) | 16.6 |
| El-Suez | 563.966 | 45 (16.8%) | 8.0 |
| Port-Said | 603.787 | 58 (21.6%) | 9.6 |
| North Sinai (El-Arish) | 421.576 | 73 (27.2%) | 17.3 |
| Total | 2689.161 | 268 (100.0%) | 10 |

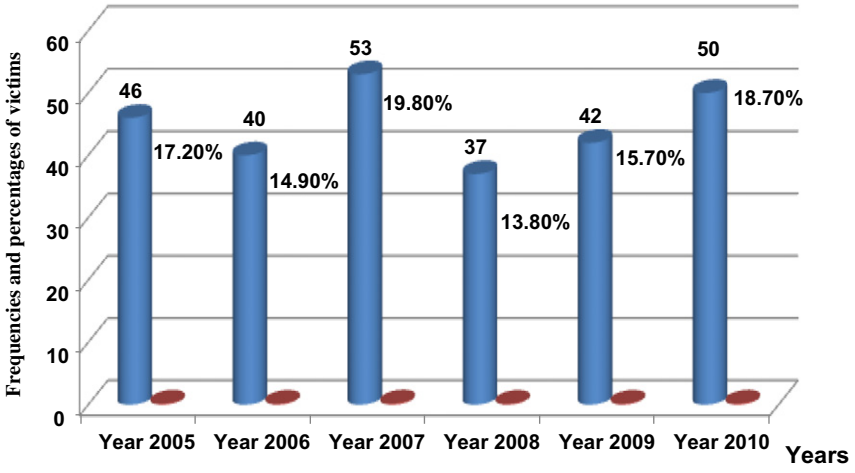


**Figure 1** Distribution of the victims in the studied cases according to years of the study.

**Table 2** Relation between age and gender among victims of firearm injuries in Suez Canal Area cities during the period from 2005 to 2010.

| Gender | Age | | | | | | |
|---|---|---|---|---|---|---|---|
| | Second decade | Third decade | Fourth decade | Fifth decade | Sixth decade | Above sixth decade | Total |
| *Male* | | | | | | | |
| Count | 45 | 115 | 55 | 22 | 14 | 8 | 259 |
| % Of total | 16.8 | 42.9 | 20.5 | 8.2 | 5.2 | 3.0 | 96.6 |
| *Female* | | | | | | | |
| Count | 3 | 4 | 2 | 0 | 0 | 0 | 9 |
| % Of total | 1.1 | 1.5 | 0.7 | 0 | 0 | 0 | 3.4 |
| *Total* | | | | | | | |
| Count | 48 | 119 | 57 | 22 | 14 | 8 | 268 |
| % Of total | 17.9 | 44.4 | 21.3 | 8.2 | 5.2 | 3.0 | 100.0 |
| Statistics | Chi square = 5.537 | | | $P = 0.013^*$ | | | |

* Statistically significant.

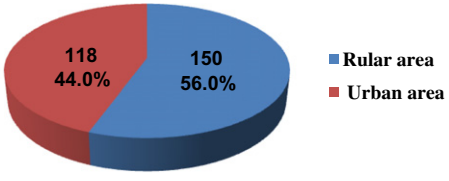


**Figure 2** Distribution of the victims in the studied cases according to place of violence.

crimes occurred in the summer (144 cases; 53.7%). Of these, 53 cases (19.8%) occurred at night. In the spring (70 cases; 26.1%), 22 cases (8.2%) occurred in the afternoon. In winter, there were 38 cases (14.2%), 11 of which (4.1%) occurred at night. Finally, in autumn, 16 cases (6.0%) took place. The most common time for firearm crimes was at night (88 cases; 32.8%), while 74 cases (27.6%) occurred in the afternoon, 50 cases (18.7%) were at midnight, 30 cases (11.2%) occurred at noon, and 26 cases (9.7%) occurred in the morning. There

**Table 3** Relation between time of the crime and season among victims of firearm injuries in Suez Canal Area cities during the period from 2005 to 2010.

| Season | Time of the crime | | | | | Total |
|---|---|---|---|---|---|---|
| | Morning | Noon | Afternoon | Night | Mid-night | |
| *Winter* | | | | | | |
| Count | 4 | 4 | 10 | 11 | 9 | 38 |
| % Of total | 1.5 | 1.5 | 3.7 | 4.1 | 3.4 | 14.2 |
| *Spring* | | | | | | |
| Count | 6 | 8 | 22 | 20 | 14 | 70 |
| % Of total | 2.2 | 3.0 | 8.2 | 7.5 | 5.2 | 26.1 |
| *Summer* | | | | | | |
| Count | 14 | 16 | 38 | 53 | 23 | 144 |
| % Of total | 5.2 | 6.0 | 14.2 | 19.8 | 8.6 | 53.7 |
| *Autumn* | | | | | | |
| Count | 2 | 2 | 4 | 4 | 4 | 16 |
| % Of total | .7 | .7 | 1.5 | 1.5 | 1.5 | 6.0 |
| *Total* | | | | | | |
| Count | 26 | 30 | 74 | 88 | 50 | 268 |
| % Of total | 9.7 | 11.2 | 27.6 | 32.8 | 18.7 | 100.0 |
| Statistics | Chi square = 3.839 | | $P = 0.397$ | | | |

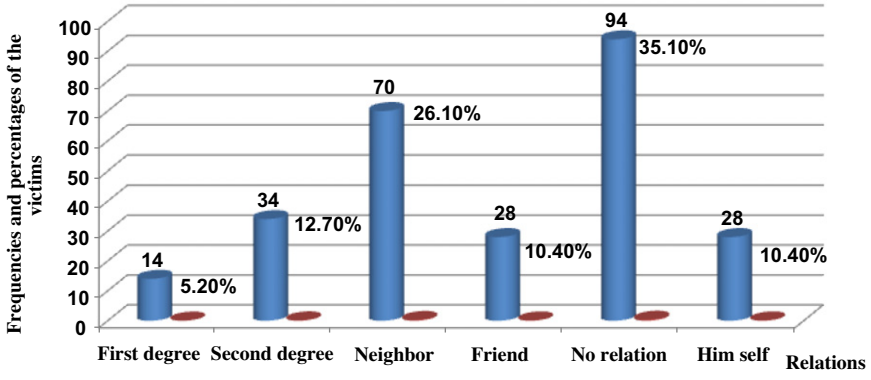


**Figure 3** Distribution of the victims in the studied cases according to their relation with the assailants.

were no statistically significant differences between the previous results (Table 3). The victims in 94 cases (35.1%) had no relationship with the assailants, 70 cases (26.1%) were neighbors, 34 cases (12.7%) were of second-degree relationships, 14 cases (5.2%) were of first-degree relationships, and 28 cases (10.4%) were of suicide (Fig. 3). The occupations of 98 victims of the cases (36.6%) were not available, 80 cases (29.9%) did illegal work (thieves, drug dealers, and hooligans), 17 cases (6.3%) were farmers, students and housewives represent 12 cases (4.5%) each, 11 cases (4.1%) were fishermen, unemployed cases were 16 (6.0%), manual workers represent eight cases (4.5%), and policemen represent nine cases (3.4%). On the other hand, in 109 cases (40.7%), the assailants did illegal work, 53 (19.8%) of them were for the purpose of robbery. The occupations of 99 assailants (36.9%) were not available, 30 cases (11.2%) of them were due to battle, 19 cases (7.1%) were farmers, 5 cases (1.9%) were due to previous problems, the unemployed and fishermen represent eight cases (3.0%) each, and policemen represent 6 cases (2.2%), all of the latter due to gun battles (chasing criminals). There were statistically significant differences between the previous results (Tables 4 and 5).

**Table 4** Distribution of victims and assailants in the studied cases according to occupation.

| Occupation | Victims | | Assailants | |
|---|---|---|---|---|
| | Numbers | Percent (%) | Numbers | Percent (%) |
| Student | 12 | 4.5 | 6 | 2.2 |
| Worker | 8 | 3.0 | 7 | 2.6 |
| Employee | 5 | 1.9 | 6 | 2.2 |
| Unemployed | 16 | 6.0 | 8 | 3.0 |
| Farmer | 17 | 6.3 | 19 | 7.1 |
| House wife | 12 | 4.5 | 0 | 0 |
| Not available | 98 | 36.6 | 99 | 36.9 |
| Illegal work | 80 | 29.9 | 109 | 40.7 |
| Fisherman | 11 | 4.1 | 8 | 3.0 |
| Policeman | 9 | 3.4 | 6 | 2.2 |
| Total | 268 | 100.0 | 268 | 100.0 |

**Table 5** Relation between occupation of assailants and circumstances of firearm action among studied cases.

| Occupation of assailant | Circumstances of firearm action | | | | | | | Total |
|---|---|---|---|---|---|---|---|---|
| | Battle | Accidental | Playing with firearm | Revenge | Robbery | Previous problems | Suicide | |
| *Student* | | | | | | | | |
| Count | 2 | 2 | 0 | 0 | 0 | 0 | 2 | 6 |
| % Of total | .7 | .7 | 0 | 0 | 0 | 0 | .7 | 2.2 |
| *Worker* | | | | | | | | |
| Count | 2 | 3 | 0 | 0 | 0 | 2 | 0 | 7 |
| % Of total | .7 | 1.1 | 0 | 0 | 0 | .7 | 0 | 2.6 |
| *Employee* | | | | | | | | |
| Count | 1 | 2 | 2 | 0 | 0 | 0 | 1 | 6 |
| % Of total | .4 | .7 | .7 | 0 | 0 | 0 | .4 | 2.2 |
| *Unemployed* | | | | | | | | |
| Count | 2 | 0 | 0 | 0 | 2 | 2 | 2 | 8 |
| % Of total | .7 | 0 | 0 | 0 | .7 | .7 | .7 | 3.0 |
| *Farmer* | | | | | | | | |
| Count | 8 | 1 | 3 | 1 | 1 | 5 | 0 | 19 |
| % Of total | 3.0 | .4 | 1.1 | .4 | .4 | 1.9 | 0 | 7.1 |
| *Not available* | | | | | | | | |
| Count | 30 | 10 | 5 | 4 | 13 | 22 | 15 | 99 |
| % Of total | 11.2 | 3.7 | 1.9 | 1.5 | 4.9 | 8.2 | 5.6 | 36.9 |
| *Illegal work* | | | | | | | | |
| Count | 33 | 0 | 0 | 2 | 53 | 19 | 2 | 109 |
| % Of total | 12.3 | 0 | 0 | .7 | 19.8 | 7.1 | .7 | 40.7 |
| *Policeman* | | | | | | | | |
| Count | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 6 |
| % Of total | 2.2% | 0 | 0 | 0 | 0 | 0 | 0 | 2.2 |
| *Fisherman* | | | | | | | | |
| Count | 5 | 0 | 0 | 2 | 0 | 1 | 0 | 8 |
| % Of total | 1.9% | 0 | 0 | .7 | 0 | .4 | 0 | 3.0 |
| *Total* | | | | | | | | |
| Count | 89 | 22 | 14 | 9 | 61 | 51 | 22 | 268 |
| % Of total | 33.2 | 8.2 | 5.2 | 3.4 | 22.8 | 19.0 | 8.2 | 100.0 |
| Statistics | Chi square = 1.403 | | | $P = 0.000^*$ | | | | |

* Statistically significant.

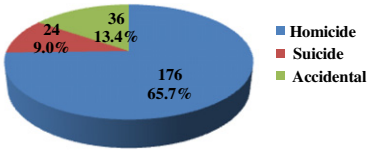


**Figure 4** Distribution of the dead victims in the studied cases according to manner of death.

Death was the most common outcome. Fatal injuries constituted 236 cases (88.1%), and most were homicides (176 cases; 65.7%. Accidents accounted for 36 cases (13.4%) and 24 cases (9.0%) were suicides (Fig. 4). Complete recovery occurred in 14 cases (5.2%), cures with permanent infirmity occurred in 11 cases (4.1%), and cures with complications occurred in seven cases (2.6%) (Fig. 5). In 85 cases (67.5%) of the fatalities, death occurred at the scene of the crime; while in six cases (4.8%), death occurred during treatment (Fig. 6). The most common site of injury was the chest (67 cases; 25.0%). 54 cases (20.1%) were homicides, followed by head injuries in 53 cases (19.8%), 33 cases (12.3%) of homicide, and 10 cases (3.7%) of suicide. In 38 cases (14.2%), the site of injury was the chest and abdomen; all of these were homicides. In seven cases (2.6%), the site of injury was the mouth, all of which were suicides. In 24 cases (9.0%), the site of injury was the upper limbs; 22 (8.2%) of these victims are still alive. In 12 cases (4.5%), the site of injury was the lower limbs. Of these, 10 (3.7%) are still alive. Two cases (0.7%) represented accidental death. There were statistically significant differences between the previous results (Table 6). Automatic (machine) guns were responsible for 72 cases (26.9%), and locally made shotguns were responsible for 61 cases (22.8%). Homemade guns represented 47 cases (17.5%); automatic pistols were responsible for 28 cases (10.4%); revolvers were responsible for 23 cases (8.6%); air pistols were responsible for 20 (7.5%) cases; and non-rifled sporting guns were responsible for 17 cases (6.3%) of the total firearm injuries (Fig. 7).

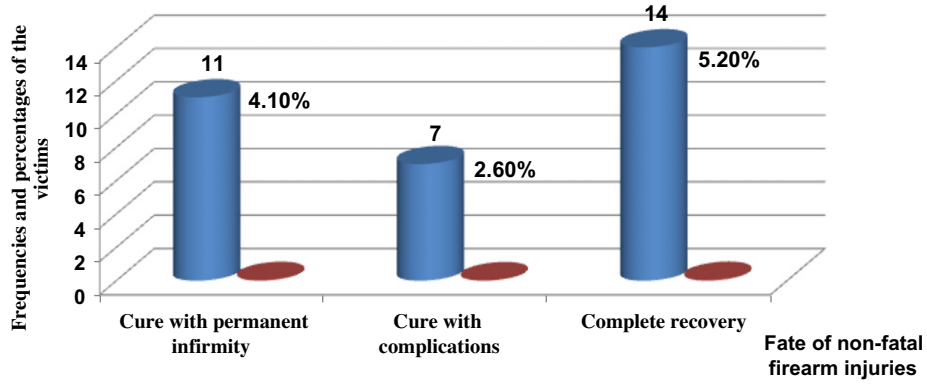


**Figure 5** Distribution of the victims in the studied cases according to fate of nonfatal firearm injuries.

**Table 6** Relation between site of inlet and manner of death among studied cases.

| Manner of death | Site of inlet | | | | | | | | | | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Head | Neck | Chest | Abdomen | Upper limps | Lower limps | Mouth | Back | Chest and abdomen | Abdomen and back | |
| *Homicide* | | | | | | | | | | | |
| Count | 33 | 21 | 54 | 10 | 0 | 0 | 0 | 8 | 38 | 12 | 176 |
| % Of total | 12.3 | 7.8 | 20.1 | 3.7 | 0 | 0 | 0 | 3.0 | 14.2 | 4.5 | 65.7 |
| *Suicide* | | | | | | | | | | | |
| Count | 10 | 4 | 3 | 0 | 0 | 0 | 7 | 0 | 0 | 0 | 24 |
| % Of total | 3.7 | 1.5 | 1.1 | 0 | 0 | 0 | 2.6 | 0 | 0 | 0 | 9.0 |
| *Accidental* | | | | | | | | | | | |
| Count | 10 | 10 | 10 | 2 | 2 | 2 | 0 | 0 | 0 | 0 | 36 |
| % Of total | 3.7 | 3.7 | 3.7 | .7 | .7 | .7 | 0 | 0 | 0 | 0 | 13.4 |
| *Victim is still alive* | | | | | | | | | | | |
| Count | 0 | 0 | 0 | 0 | 22 | 10 | 0 | 0 | 0 | 0 | 32 |
| % Of total | 0 | 0 | 0 | 0 | 8.2 | 3.7 | 0 | 0 | 0 | 0 | 11.9 |
| *Total* | | | | | | | | | | | |
| Count | 53 | 35 | 67 | 12 | 24 | 12 | 7 | 8 | 38 | 12 | 268 |
| % Of total | 19.8 | 13.1 | 25.0 | 4.5 | 9.0 | 4.5 | 2.6 | 3.0 | 14.2 | 4.5 | 100.0 |
| Statistics | Chi square = 3.469 | | | | | $P = 0.000^*$ | | | | | |

* Statistically significant.

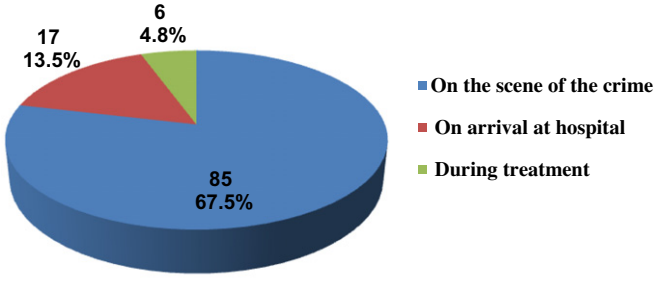


**Figure 6** Distribution of the victims in the studied cases according to place of death.

## 4. Discussion

Injuries from firearms are a major health problem that severely affects the criminal justice and health-care systems. Such injuries are common in Egypt. Despite the magnitude of this problem, little is known about the epidemiologic characteristics of these injuries.[17]

The current study is a retrospective analysis of firearm injuries and deaths examined by the Medico-legal Department of the Ministry of Justice in the Suez Canal Area during the

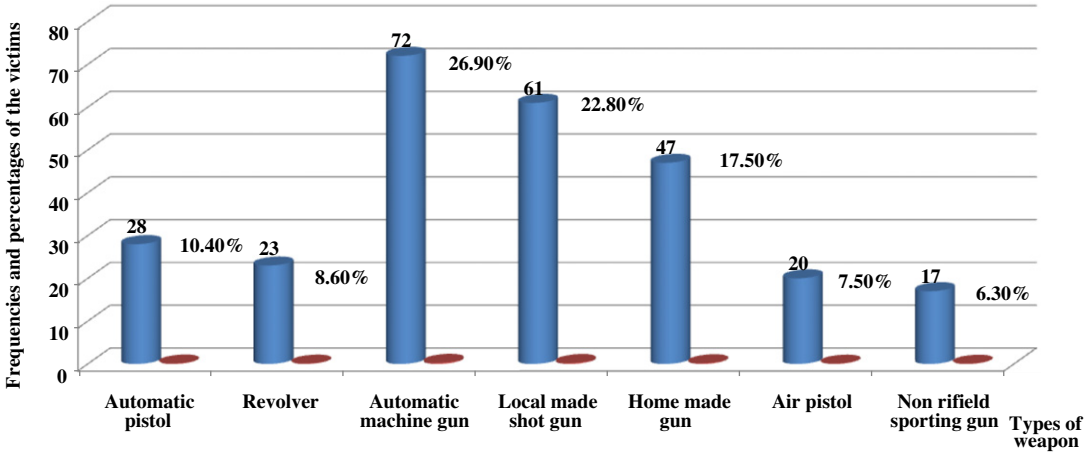


**Figure 7** Distribution of the victims in the studied cases according to types of weapon used in the crime.

period between January 2005 and December 2010. The present study included 268 victims of fatal firearm injuries in a 6-year period. It was found that El-Arish City had the highest occurrence of firearm injuries and fatalities (17.3/100,000), and most of the victims were from El-Arish City (73 cases; 27.2%), while the lowest occurrence was in Ismailia (7/100,000). Total prevalence in Suez Canal Area was 10/100,000.

A study carried out in Italy reported that total number of firearm fatalities studied was 717, representing 27.7% of all medico-legal autopsies performed over a 16-year period.[18] In the current study, the number of cases ranged from 37 (13.7%) to 53 (19.8%) per year, with the largest number occurring in 2007 (53 cases; 19.8%), followed by 2010 (50 cases; 18.7%), then 2005 (46 cases; 17.2%), then 2009 (42 cases; 15.7%), then 2006 (40 cases; 14.9%), and finally 2008 (37 cases; 13.8%).

In this study, the most affected age group was the age group of the third decade (119 cases; 44.4%), followed by the fourth decade (57 cases; 21.3%) and then the second decade (48 cases; 18.0%). The least affected age group was above the sixth decade (8 cases; 3.0%). The majority of the victims were male (259; 96.6%), while females represent 9 cases (3.4%), resulting in a male to female ratio of 28.8:1.

A similar study done in Assiut Governorate reported that the highest incidence of firearm injuries and fatalities occurred in the age group 21–30 years (31.3%), followed by the age group 31–40 years (25.5%). Most victims were male (86.3%).[16] Our results are similar to those reported in El-Monofia Governorate, Egypt, during the year 2000, where the highest incidence occurred in the age group 20–30 years, and the majority of victims were male (88.6%).[19] A retrospective study recorded all firearm fatalities in El-Fayoum Governorate during the 7 year period from 2000 to 2006. The study reported that the most commonly affected age group in the studied victims was the third decade (29.6%), followed by the fourth decade (25.4%). The least affected age group was above the sixth decade (1.4%).[20]. The results of the current study differ from that of a study done in Qena Governorate that outlined the pattern of firearm injuries. There, the rate of incidence was in the age group 30–40 years (49.5%), followed by the age group 40–50 years (25.2%). No victims were younger than 20 years, and most of the victims were male (94.2%).[21] Our results agree with those of the study in Pakistan that collected data about firearm injuries and fatalities in the years 2007 and 2008. It was shown that almost all age groups were represented, with the majority of victims being adults and middle-aged persons. Amazingly, the vast majority of studies agree that the most common victims of firearm-related homicides were male.[22] Studies were carried out in India,[23] Germany,[24] and Nigeria[25] to evaluate firearm injuries revealed that most victims were male in the age group of 20–30 years. In the Transkei region of South Africa, a study to determine the prevalence of firearm fatalities was carried out and it was found that, males represent 82% of the victims.[26] In England, a survey studied the pattern of firearm injuries that represented that, most victims of firearm injuries are male (94.5%), with the median age being 28 years for males and 36 years for females.[27] Legal ownership of guns, male gender, and youth have been identified as risk factors for firearm injuries.[28]

It can be said that youth pick more fights and are therefore more engaged and aggressive. The elderly are wiser and act with restraint; their inclination is to avoid fights rather than provoke them. Males are more susceptible to strain and despair in their day-to-day activities because they usually go to work, where violence is ensured. Males are more affected than females because they are expected to maintain the moral dignity of the family and any threat to it that can lead to violence, while females tend to stay indoors. Also, females are less likely to participate in fights that could lead to murder.

In the current study, 150 (56.0%) out of 268 cases of firearm crimes occurred in rural areas, while 118 cases (44.0%) occurred in urban areas. A study carried out in El-Fayoum Governorate to study firearm fatalities found that 52 cases (73.2%) of firearm crimes occurred in rural areas while 19 cases (26.8%) occurred in urban areas.[20] A study carried out in Menoufiya University Hospital on firearm injuries reported that such injuries were more common in rural areas than in urban areas (72.41% and 27.59%, respectively). It can be said that firearm crimes are more common in rural areas. This may be because farmers always keep weapons to protect their lands and rural areas have less legal control than urban areas.

In this study, most firearm crimes occurred in the summer (144 cases; 53.7%), while 53 cases (19.8%) occurred at night. Spring accounted for 70 cases (26.1%), followed by winter (38 cases; 14.2%), and finally autumn (16 cases; 6.0%). The

most common time for firearm crimes was at night (88 cases; 32.8%), while 74 cases (27.6%) occurred in the afternoon, 50 cases (18.7%) were at midnight, 30 cases (11.2%) occurred at noon, and 26 cases (9.7%) occurred in the morning. These findings are partially in agreement with those that reported that most injuries occurred in summer months and the fewest occurred in winter months, and the majority of firearm injuries occurred at night.[29] This study disagrees with a study carried out to determine the prevalence of fatal and nonfatal firearm injuries in Alexandria, Egypt. The researchers reported that 31.5% of injuries occurred during autumn months, while the least occurred in summer months (20.4%). The same study also found, however, that most firearm injuries (46.3%) occurred at night.[30]

It may be that firearm injuries are more common in the summer due to the length of daylight and high temperatures in the summer, which makes people prone to conflict and fighting. The fact that majority of firearm injuries occurred at night may be because night is when illegal work is done and wedding parties take place in rural areas, where accidental shootings could happen. In the current study, 94 (35.1%) victims had no relationship with the assailant, 34 (12.7%) had second-degree relationships, and 14 (5.2%) had first-degree relationships. A study carried out in Alexandria reported that, regarding the relationships between the victims and assailants, 83.3% were strangers, while in 16.7% of cases, the assailant was a member of the family or a friend.[30] This may be because conflicts between relatives of one family often take routes other than live ammunition to express anger and emotion, and usually there are those who try to intervene to solve problems in the family.

In the present study, the majority of the victims' occupations (98 cases; 36.6%) were not recorded, and the second largest group of victims (80 cases; 29.9%) did illegal work (thieves, drug dealers, and hooligans). On the other hand, majority of the assailants' occupations (109 cases; 40.7%) were illegal works, 53 cases (19.8%) were robberies, the occupation of 99 assailants (36.9%) were not available, 30 cases (11.2%) were due to gun battles with the victims, 19 cases (7.1%) were farmers, five cases (1.9%) were due to previous problems, unemployed and fishermen represented eight cases (3.0%) each, and policemen represented six cases (2.2%), all of the injuries of which occurred in battle (chasing criminals). A study carried out in El-Fayoum Governorate to study cases of firearm fatalities during a 7-year period reported that, out of the total of 71 cases, 41 victims were farmers, 10 were policemen, and nine had no employment.[20] A study done to determine the medico-legal aspect of firearm injury cases admitted to Menoufiya University Hospital over two years found that, out of a total of 29 cases, seven victims had no work.[31] A study carried out in Alexandria to determine the prevalence of fatal and nonfatal firearm injuries found that out of a total of 54 cases, 11 victims and 10 assailants did illegal work, nine victims and 16 assailants were police officers, eight victims and two assailants were students, and four victims and five assailants were farmers.[30] In the current study, the highest numbers and percentages of firearm users among those who did illegal work were accounted for because persons who do illegal work are more liable to deal with weapons, especially firearms, which permit them to work at a distance from their enemies and protect themselves during fights. This makes them more liable to become victims or assailants.

Our studies show that firearm injuries are the leading cause of homicidal deaths with 176 cases (65.7%), while suicide represents 24 cases (9.0%) and accidental deaths represent 36 cases (13.4%). This is in partial agreement with a retrospective one-year study in Tehran period that showed that there were 89 firearm fatality investigations. Of these, 60.7% were homicides, 30.3% were suicides, 4.5% were accidental, and 4.5% were unclassifiable.[32] A similar result was reported in Edirne, Turkey, in which homicides represent 68.3% of firearm fatalities.[33]

A retrospective study reviewed deaths from the records of the Forensic Medicine Centre in Dammam, Saudi Arabia, for a five-year period from 2000 to 2006. The study reported that in terms of the manner of death, 55 cases (86%) were homicides, followed by seven cases (10.9%) of suicide and two cases (3.1%) that were accidental.[34]

In Bari, Italy, a study performed over a 16-year period from 1988 to 2003 reported that a total number of homicide cases were 634, accounting for 88.4% of all firearm deaths. Another 82 cases were suicides, representing 11.5% of all firearm deaths, and only one accidental gunshot fatality occurred.[18] In a similar study of the Menoufiya Governorate, homicide occurred in 71.4%, accidents in 28.6%, and no suicides occurred at all.[19]

This result is different from results of a study done in Qena Governorate to determine the pattern of firearm injuries in the year 2008. Out of the total number of 103, homicide represents 100 cases (97.1%), suicide accounted for one victim (0.9%), and two victims (1.9%) were injured in accidents. In Assiut Governorate, the manner of death was homicide in 86.9% of the cases, accidents in 12.2%, and suicide in 0.89% of the firearm injuries and deaths.[16] Our data agree with several other studies from various cities in Pakistan where firearms were the leading cause of homicidal deaths, representing 59.8% of cases in the DI Khan district.[22] Studies from the United States and other developed countries reported that firearms are used in more than 60% of all homicides, over 25% of all assaults, more than 35% of all robberies and almost half of all suicides.[17] In contrast to our study, in Denmark and New Zealand, studies showed that suicides accounted for the vast majority of firearm fatalities, namely 80% and 75.5%, respectively.[9–35] The high incidence of homicidal deaths in the present study in Suez Canal Area cities may be due to the significant use of unlicensed firearms, which are usually smuggled into commit terrorist acts. This situation occurs in places where weapons are readily available or state legislation allows people to hold firearms. Illicit means of acquiring firearms goes hand-in-hand with drug use.

Suicidal fatalities comprised 24 cases (9.0%) in this study. This low suicide rate may be explained by the low socioeconomic status of this area, where very few people can acquire costly factory-made licensed guns. Gunshot suicides are committed with legally owned firearms, resulting in a very small percentage of people committing suicide with firearms in Suez Canal Area; instead, they tend to use easier and cheaper methods like hanging or poisoning.

In the current study, complete recovery occurred in 14 cases (5.2%), cures with permanent infirmities occurred in 11 cases (4.1%), and cures with complications occurred in seven cases (2.6%). In 85 cases (67.5%) of the total fatalities, death occurred at the scene of the crime; while in six cases (4.8%), death occurred during treatment.

A preliminary study of firearm injuries and deaths in Qena Governorate, Egypt in 2008 reported that from the total of 103 firearm injuries and deaths, recovery was the end result of 49 cases, while permanent infirmity occurred in nine victims.[21] A study carried out at Menoufiya University Hospital to identify some medico-legal aspects of firearm injuries over two years reported that out of the total 29 injury cases, cure occurred in six cases, a cure with complications occurred in one case, and permanent infirmity occurred in 12 cases.[31] In a retrospective and prospective study in Alexandria for 5 1/2 years, among the total of 54 cases, recovery occurred in 21 cases, permanent infirmity occurred in eight cases, immediate death occurred in 13 cases and death after admission to hospital occurred in eight cases.[30]

This event may occur as a result of many factors and circumstances surrounding the crime, including the site of the injury, the severity of the wound, the quality of the weapon used, the quality and number of projectiles, the direction and extent of launching the shot, the speed of rescuing the victim, and whether there was a surgical intervention.

In the current study, the most common site of injury was the chest (67 cases; 25.0%). Fifty-four cases (20.1%) of these were homicides. Head injuries accounted for 53 cases (19.8%), 33 cases (12.3%) of which were homicides and 10 of which (3.7%) were suicides. In 38 cases (14.2%), the site of injury was the chest and the abdomen. All these cases were homicides. In seven cases (2.6%), the site of injury was the mouth; all these cases were suicides. In 24 cases (9.0%), the site of injury was the upper limbs. Of these victims, 22 (8.2%) are still alive. In 12 cases (4.5%), the site of injury was the lower limbs. Ten (3.7%) of these victims are still alive. Finally, two cases (0.7%) were accidental. There were statistically significant differences between the previous results. In agreement with these results, a preliminary study of firearm injuries and death in Qena Governorate in Egypt reported that the most common site of entrance wounds was the chest and the abdomen, representing 23.3% and 22.3%, respectively.[21] Also, in a similar study in El-Fayoum Governorate, the most common site was the chest (21 cases; 29.6%), followed by the abdomen and the head (18 cases each; 25.4%), then back (6 cases; 8.5%) and finally the mouth in one case (1.4%).[20] In Turkey, the most common site for entrance wounds is the chest, representing 32% of the total firearm injuries.[33]

In Dammam, Saudi Arabia, the most common sites of firearm injury were the head (36.7%) and the chest (28.7%).[34]

It can be said that in homicide deaths, the assailant tends to hit the victim in a fatal area such as the chest or head. Also, persons who commit suicide tend to shoot themselves in dangerous areas such as the head and the mouth, but in accidental injuries or in cases in which assailants use firearms only to threaten, victims are usually injured in a less dangerous site such as the upper or lower limbs.

This study reported that 72 crimes (26.9%) were committed using automatic (machine) guns, 61 crimes (22.8%) were committed using locally made shot guns, 47 crimes (17.5%) were committed using homemade guns, and automatic pistols were used in crimes in 28 cases (10.4%). Crimes committed with a revolver represent 23 cases (8.6%), while crimes committed using non-rifled sporting guns represent 17 cases (6.3%), and air pistol usage represents only 20 cases (7.5%). A study of firearm fatalities in El-Fayoum Governorate during a 7-year period found that, among the total number of 71 fatalities, there were 55 cases committed by using handmade firearms[20], while in Alexandria, a study found that the most common type of handgun used was either a revolver or a pistol (51.9%), followed by homemade shotguns in 25.9%, and shotguns and homemade handguns constituted 11.1% of cases for each.[30]

The high presence of automatic (machine) weapons in the Suez Canal Area is because this area has witnessed many successive wars, and these weapons represent the traces of wars and are not allowed. Furthermore, the spread of drug trafficking and cultivation of narcotic plants in the Sinai makes assailants more likely to use firearms to protect their illegal activities, especially automatic (machine) weapons and locally made shotguns.

Assailants tend to buy homemade guns, which are cheaper. No licenses are given out to them, so tracing gun ownership is almost impossible. Being cheap, they also get damaged and are often discarded after the crime. Hence, it becomes easier to commit crimes and flee without being detected. Crimes involving firearms indicate that firearms are sold legally and illegally across the country without a lot of control.[36]

## 5. Conclusion and recommendations

Research on firearm injuries proves that certain changes may minimize mortality, disability, and costs to the community. There is a need to decrease the number of firearms used and sold in Egypt. We need to eradicate illicit local community gun manufacturing units. There is a need for educational efforts, and community and societal curriculum to reduce the number of firearm-related injuries.

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